Chapter 3: The Delta Ecosystem and Economic Sustainability

The history of the Sacramento-San Joaquin Delta and its ecosystem, its current status and value, and the various proposals to repair or restore the ecosystem are covered in numerous reports and technical papers. A good overview, which includes 12 pages of technical references, is provided by the Delta Ecosystem White Paper, dated October 18, 2010, prepared for the Delta Stewardship Council.[16] The executive summary states that:

> *"The Delta and Suisun Marsh ecosystem, as a large component of the San Francisco Estuary, was once one of the most biologically productive and diverse ecosystems on the west coast, supporting a wide array of native plant and wildlife species and providing important habitat for many migratory species. The Delta ecosystem is now in peril. As a result of human activity to reclaim farmland, protect areas from flood, and provide water for agriculture and communities; discharge of wastes from agriculture, industry, and urban areas; and the introduction of harmful invasive species, the Delta has been modified in ways that adversely influence ecosystem function and compromise its ability to support a healthy ecosystem. These changes not only affect the species that live there, but also the ecosystem services that benefit humans, such as improved water quality, agricultural productivity, healthy commercial and sport fisheries, flood protection, and recreation."*

The purpose of this chapter is to list key considerations as background to a more focused assessment of the evolving Delta economy centered on agriculture, recreation and tourism, and infrastructure. While a healthy ecosystem has intrinsic economic values, as stated in Chapter 1, our focus is on the more tangible economic impacts on the economy of the Delta. Ecosystem restoration will have a variety of impacts on the Delta economy, both positive and negative.

1 Brief Background

In the early 19th century the Delta was composed of intertidal wetlands, riparian forest and scrub, nontidal wetlands and grasslands, floodplains, and seasonal wetlands, all contained within an intricate network of branching waterways, as shown in Figure 11. Following the Gold Rush, encouraged by state and federal legislation, most of the Delta was drained and leveed for agricultural purposes. This transformation was largely completed by the early 20th century, resulting in the geometry of the Delta that we know today. Other changes include the introduction of an enormous quantity of mining debris in the second half of the 19th century prior to the ban on hydraulic mining on federal lands and the subsequent widening and deepening of the lower Sacramento River by the federal government in order to facilitate the flushing of mining debris through the Delta; the dredging of the Sacramento and Stockton deep-water ship channels; the diversion of waters upstream from the Delta by various local, state, and federal irrigation projects; the regulation of river flows by the construction of dams for both flood control and irrigation purposes; and the extraction of water from the South Delta by the federal Central Valley Project and the State Water Project.

The consequence of all this alteration of the natural environment has been substantial modification of the ecosystem, judged by most observers to be in a decline that has steepened in recent years. As one measure, salmon runs continued in the millions for some years even after the first large dams were built but have greatly declined in recent years. Of particular note is the "pelagic organism decline" (POD) of the first decade of the current century. This has been the subject of exhaustive study and a comprehensive report prepared by the Inter-Agency

[16] http://www.deltacouncil.ca.gov/delta-plan

Ecological Program (IEP).[17] While there are many differing opinions about the principal reasons for this decline, a common observation is that the Delta has gradually been transformed from an estuarine environment to more that of a weedy lake that favors invasive species over native species.

2 Stressors

Good discussions of the "stressors" or "drivers" of the Delta ecosystem can be found in the IEP report on the POD and in the review performed by the Independent Science Board at the request of the DSC.[18] Because of the continuing debate over the relative importance of individual stressors or combination of stressors, we do not attempt a formal ranking of stressors but we do attempt to sort and list them, below, in a rational manner in order to inform subsequent discussion. Interactions between the listed stressors can be as important, or more important, than any of them in isolation. This is part of the reason that it is so difficult to complete a satisfactory effects analysis for any one or a combination of conservation measures.

A. Climate and flow

   a. Climate variability, including both the magnitude of winter and spring freshwater pulses and oceanic conditions

   b. Flow regime, the loss of natural flows through the Delta: reduced flows out of the San Joaquin and cross-flows that result from Sacramento River water being drawn to the export pumps in the South Delta

B. Landscape and vegetation: in particular the loss of connectivity, complexity, and variability

C. The measures that result from A and B: salinity, temperature, turbidity, natural nutrients

D. Introduced substances: unnatural nutrients, contaminants, disease

E. Harvest: entrainment, predation, fishing

One of the reasons that there is continuing debate about the relative importance of these stressors is that, as explained in the landmark paper on altered flow regimes by Bunn and Arthington,[19] the necessary detailed observations were not made during the decline of most rivers and estuaries to allow the development of robust detailed correlations of causes and effects on a scientific basis. Bunn and Arthington express the hope that that will be done as these ecological systems are restored, and that that will guide adaptive management of restoration efforts; in the meantime there is a need to go forward in accordance with broader principles and best management practices.

[17] http://science.calwater.ca.gov/pod/pod_index.html
[18] http://deltacouncil.ca.gov/docs/2011-01-26/final-memo-phil-isenberg-delta-isb-addressing-multiple-stressors-and-multiple-goals-
[19] Stuart E. Bunn and Angela H. Arthington, Basic Principles and Ecological Consequences of Altered Flow Regimes for Aquatic Biodiversity", Environmental Management, Vol. 30, No. 4 (2002), pp. 492–507

3 Possible conservation and ecosystem restoration measures

Possible conservation and ecosystem restoration measures are being studied by the Bay Delta Conservation Plan (BDCP),[20] the Department of Fish and Game in connection with their Ecosystem Restoration Plan,[21] and the Delta Conservancy as part of its Strategic Plan development. Flow and water quality standards, which might have a very significant impact on the Delta ecosystem, are also under consideration by the State Water Resources Control Board.

While there is continuing debate over the importance of restoring more natural flows through the Delta, it seems clear that ecosystem restoration should start with a solution to the existing conveyance problems that makes a significant improvement in natural flows through the Delta. But many additional conservation measures might need to be taken to fully achieve the coequal goals. The broad principles that should be followed are relatively clear and should include restoring connectivity, complexity, and variability to the Delta ecosystem on a landscape scale (i.e., throughout the Delta) rather than on a piecemeal basis. It must also be recognized that the Delta ecosystem is not a closed system and that the ocean-bay-Delta-rivers system must be addressed as a whole.

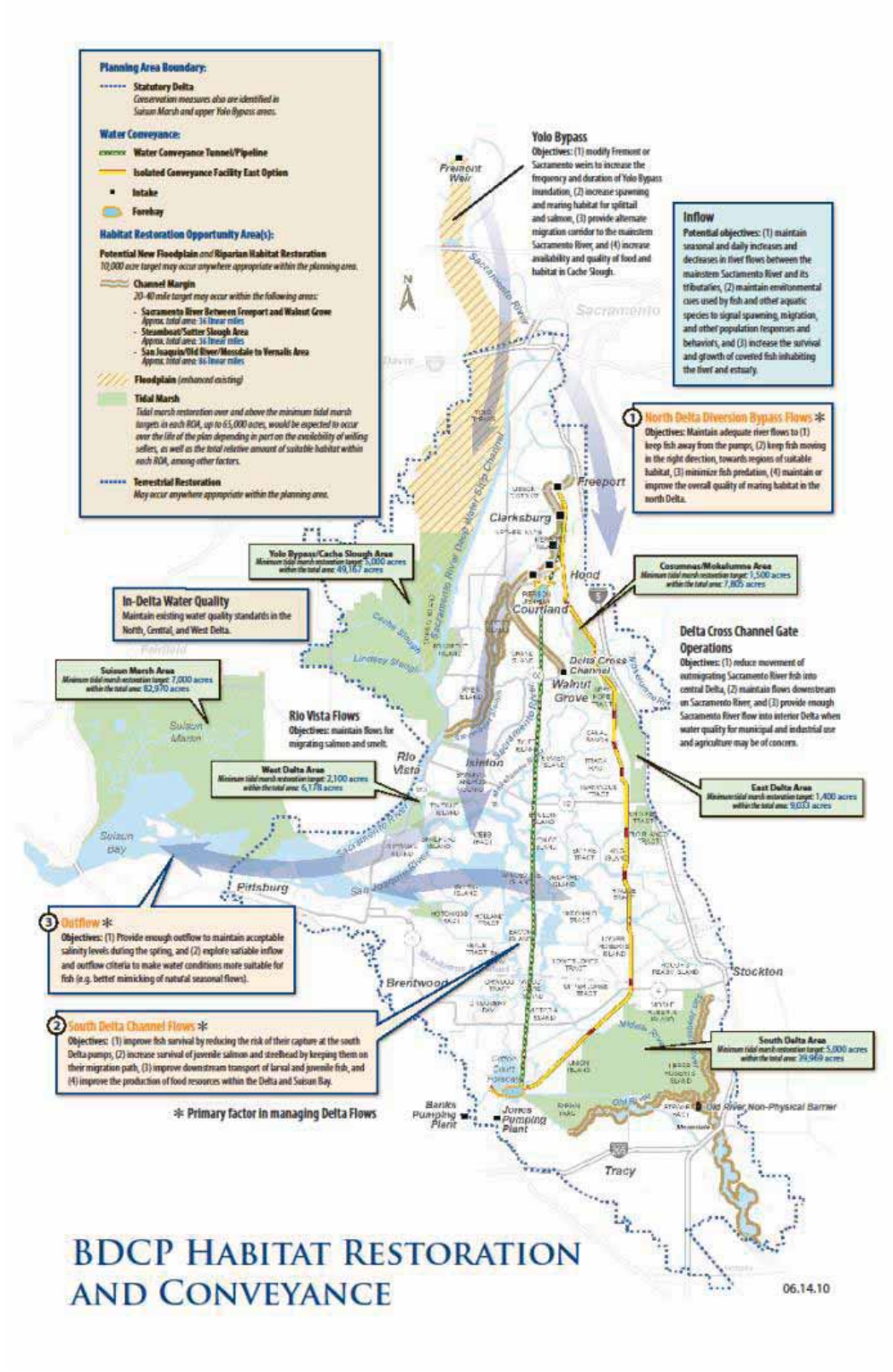
Most of the options under consideration by the BDCP attempt to improve flows in the Delta by moving part or all of the intakes from the south Delta to the north Delta rather than reducing the amount of water exported to the state and federal water projects. Moving the intakes would improve natural flows by minimizing the “reverse flows” that presently occur in the Old and Middle Rivers when the south Delta pumps are operated at high levels. However, the gain that might result by lower fish losses at the South Bay pumps is offset to at least some extent by possible adverse impacts on salmonids in the Sacramento River. In order to deal with that issue, it is expected the operational rules for any north Delta intakes will require significant bypass flows that will limit the amount of water than can be conveyed through tunnels to the South Delta. Thus, significant through-Delta flows will still be required, resulting in a dual conveyance system of moving freshwater around the Delta in an isolated facility in tandem with the current system of through-Delta conveyance.

The net effect is that it does not appear that the conveyance measures that are part of the BDCP will by themselves have a significant effect on achieving ecological recovery of the Bay-Delta estuary. Thus, the BDCP relies on a number of additional conservation measures to promote ecological recovery. Nineteen such measures were included in the November 2010 working draft of BDCP[22] and are illustrated in the aquatic habitat restoration map[23] that is shown as Figure 8.

The most prominent and costly elements of the BDCP restoration proposals are the isolated conveyance facility and the extensive areas that are targeted for tidal marsh restoration, including areas in the interior Delta that were not necessarily tidal marshes in the historic Delta. The BDCP has estimated that just the construction cost of this plan will be $15 billion or more.

[20] http://baydeltaconservationplan.com/Home.aspx
[21] http://www.dfg.ca.gov/erp/
[22] BDCP, Working Draft, Chapter 3, November 18, 2010, http://baydeltaconservationplan.com/BDCPPlanningProcess/DocumentsAndDrafts.aspx
[23] http://baydeltaconservationplan.com/BDCPPlanningProcess/BrochuresAndFactSheets.aspx

Figure 8 BDCP Habitat Restoration[24]



[24] For a better resolution image see http://forecast.pacific.edu/desp-figs.html

4 Potential Impacts of Ecosystem Restoration on the Delta Economy

Improvements to the Delta ecosystem could have positive and negative effects on the Delta economy and quality of life. Potential positive effects include the following.

- Improving fisheries could help commercial and recreational fishing economies, although most of the economic benefit of improved salmon runs would be outside the Delta.
- Some habitat measures could increase flood protection.
- Increased freshwater flows would benefit water quality for a variety of in-Delta uses.
- Reducing contaminants would benefit water quality for a variety of in-Delta uses.
- Improved riparian habitat would improve the aesthetics of the Delta and make it a more desirable place for recreation.
- Other habitat measures could increase opportunities for wildlife viewing and related tourist activities.

However, some ecological improvements, including those listed below, would have negative effects on the Delta economy and quality of life.

- Habitat restoration could eliminate large amounts of farmland, reducing agricultural production, the Delta's largest industry.
- Some ecological restoration strategies could increase salinity, harming in-Delta uses of water.
- Some ecological restoration strategies could increase organic carbon levels in Delta water, causing problems for municipal and industrial users.
- Increased mosquito/vector problems from marsh restoration increases the risk of disease and creates a nuisance that makes the Delta less desirable for living, recreation, and tourism.
- Some marsh restoration could increase seepage and risk for levees on nearby islands.
- Some restoration measures are very expensive and will require large commitments of public financial resources from strained public budgets.

Some conservation measures would have mostly positive effects, whereas others could have large negative effects. In many instances, potential negative effects could be reduced through careful planning.

5 Ranking Ecosystem Restoration Proposals for Economic Sustainability in the Delta

The following conservation or ecosystem restoration measures appear to have the merit of complementing any increases in the natural flows through the Delta without adversely affecting existing agricultural and recreational uses in the Delta. Indeed, successful implementation of these measures would be expected to benefit recreation and potential eco-tourism.

- Restore sunken islands including Franks Tract and Western Sherman Island as tidal marsh and/or tule marsh.

- Restore the mid-channel berms which are in danger of being lost at many locations.
- Encourage the growth of native vegetation on the water side of all Delta levees, which will not only provide significant ecological benefits but also recreational and tourism benefits. At selected locations, this vegetation may be extended into the existing waterways on berms or up widened levees to create riparian habitat.
- Restore some measures of complexity to the Delta waterways: in addition to creating more natural channel margins as discussed above, make use of both set-back levees and berms to create more natural slough geometries and increase the variability of flows and residence times by modifying channel geometries by dredging and fill placement as appropriate.
- Restore historic floodplains upstream of the Delta in order to provide both flood management and ecosystem benefits.

Other conservation measures will impose some economic costs on the Delta, however, these costs can sometimes be avoided or mitigated through management and flexibility. In addition, there could be some off-setting benefits to recreation or flood control. The following list is an example of conservation measures with in-Delta economic costs that could be managed or mitigated.

- Encourage more farms to adopt habitat-friendly agricultural practices such as those already employed by The Nature Conservancy on Staten Island as well as many other farmers throughout the Delta.
- Construct new and improve existing flood bypasses.

Other proposed measures in the BDCP have potentially large negative effects on many aspects of the Delta economy with little or no offsetting benefits.[25] Not only do they take prime agricultural land out of production for uncertain ecosystem benefits, but they threaten to add significantly to water treatment costs, as discussed in Chapter 9 on Infrastructure, raise major concerns about the control of disease-carrying vectors, and have more negative than positive impacts on recreation and tourism. The most costly of these measures are:

- Isolated water conveyance facilities to move freshwater around the Delta via a tunnel or canal
- Creation of new tidal marsh areas, particularly in the interior Delta

The sizing of isolated conveyance and extent of tidal marsh restoration continue to be under evaluation. Reducing the capacity of isolated conveyance and the acreage targets for tidal marsh restoration would reduce negative effects on the Delta economy, although not necessarily in direct proportion to the changes in capacity or acres. The economic impacts of these measures are discussed in greater detail in subsequent chapters, particularly chapters in Part Two.

[25] Spending to operate and maintain the facilities will create some positive on-going economic activity in the Delta. However, much of that new spending is for energy, primarily increased electricity demand, which is a very arguable local economic benefit.